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(75) Inventors/Applicants (for US only): **CHOI, Sung-hak** [KR/KR]; #1023-407, Jugong10-danji Apartment, Sangkae8-dong, Nowon-gu, 139-760 Seoul (KR). **KIM, Jung-hoon** [KR/KR]; #237-106, Haan Jugong Bon2-danji, 769, Haan-dong, Kwangmyung-si, 423-060 Kyunggi-do (KR). **CHO, Gug-yong** [KR/KR]; #203-1401, Samsung Apartment, 419, Yuljeon-dong, Jangan-gu, Suwon-si, 440-320 Kyunggi-do (KR).

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A1

(54) Title: AN APPARATUS CONNECTED MULTI IP BROADBAND LINE ANDFallback METHOD THEREOF

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(57) Abstract: This invention aims to provide an apparatus supporting a plurality of broadband communication lines and fallback routing method thereof which supports Internet access with no disconnection while disconnecting and switching to one communication line available among a plurality of communication lines according to line condition. This present invention in order to achieve said purpose enables functions such as connecting user computer to one primary communication line among a plurality of communication lines, implementing periodical ping test to said every communication line, and disconnecting the connection between said user computer and said primary communication line when the response of primary communication line gets downed, or slower than the criteria according to the result of ping test, connecting one backup communication line of remaining communication lines except said primary line which have Internet accessibility to said user computer, implementing periodical ping test to said every communication line.

## AN APPARATUS CONNECTED MULTI IP BROADBAND LINE AND FALLBACK METHOD THEREOF

### TECHNICAL FIELD

5 This invention relates to an apparatus supporting a plurality of broadband communication lines and fallback routing method thereof which supports Internet access with no disconnection while disconnecting and switching to one communication line available among a plurality of communication lines according to line condition.

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### BACKGROUND OF THE INVENTION

In general, an user who is in demand on communication service (every communication service including Internet) needs to connect to network via modem (analog modem, digital modem, power line modem, etc.) as terminal device, and 15 communication line (telephone line, dedicated line, wireless LAN, power line, etc.).

The method in connecting network has been developed in various ways by stimulating easy accessibility and connection performance with network.

FIG. 1 shows a conventional Internet connection method via user computer. A plurality of computers(101) are connected to the hub(102) performing switch function. The hub(102) itself is connected to router(103). Needless to say, 20 computers can be directly connected to router(103). In this case, Internet user can expect higher data transfer speed and stability with the case of router compared to the case of hub(102) connected to a plurality of computers.

The said router(103) connects to the Internet network line(dedicated 25 line, xDSL, PSTN, Cable TV line, Power line etc.) externally as well as to a plurality of user computers through LAN(Local Area Network) internally.

In the case of dedicated line for Internet communication, the Internet user only can access the Internet with the dedicated line through the DSU(digital service unit) or CSU(channel service unit)(104). Herein, DSU(digital service unit) or 30 CSU(channel service unit)(104) is an digital interface device connecting user computer

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to local digital telephone loop.

Besides, in the case of xDSL or Cable TV line(but not shown), the Internet user can access the Internet with the hub and xDSL modem or cable modem.

Herein, xDSL(comprising ADSL, HDSL, SDSL, VDSL, etc.) means  
5 digital technology wherein telephone companies provide conventional copper line infra-structure.

The said conventional router(103) can not support Internet access to user in case of disconnection of corresponding communication line, since said conventional router(103) supports only one external communication line.

10 However, having no accessibility to Internet causes so much inconvenience and loss in various aspects, since Internet has inseparable relationship with the way of living.

To solve said problem, connecting device connected to 2 communication lines and to a plurality of user computers have been developed.

15 This connecting device supports line backup function which enables to communicate to other communication line if one of 2 communication lines loses it's connection, while this connecting device connects to both user computers and 2 Internet communication lines.

20 This line backup technology, for example, has been adopted in a flb100 product(ipHanaro) developed by fusion-x Company. This product enables to communicate with using both 2 communication lines while connecting 2 communication lines. And, in case of dedicated line fail, this product needs to be installed a specific program to an user computer connected to this product.

25 Therefore, this line backup technology accompanies inconvenience with manual user operation when the dedicated line fails. Furthermore, there may be a problem with no accessibility in communication for the time being, until the user disconnects dedicated line and switches to backup communication line.

#### BRIEF DESCRIPTION OF THE DRAWINGS

30 FIG. 1 shows a diagram explaining a conventional Internet connection

method via both user computer and communication line,

FIG. 2 shows a diagram explaining Internet connection routing method by using apparatus supporting a plurality of communication lines according to an embodiment of this present invention,

5 FIG. 3 shows a block diagram configuring an apparatus supporting a plurality of communication lines according to an embodiment of this present invention,

FIG. 4 shows a block diagram configuring internal central processing unit, wherein FIG. 3 is provided,

10 FIG. 5 shows a flowchart explaining fallback routing method of an apparatus supporting a plurality of communication lines according to an embodiment of this present invention.

\* BRJEF DESCRIPTION OF PARTS IN THE DRAWINGS \*

301 : Central Processing Unit

302 : Flash ROM

15 303 : RAM

304 : Internal BUS

305, 306, 307 : Network Interface Card(NIC)

308, 309, 310, 315 : Transformer

311, 312, 313 : Communication line connector

20 314 : Switching part

316 : Computer/Hub connector

41 : Ping module

42 : Disconnecting and switching module

43 : trace route module

25

DETAILED DESCRIPTION OF THE INVENTION

This present invention in order to solve said the problem in conventional technology aims to provide an apparatus supporting a plurality of broadband communication lines and fallback routing method thereof regarding functions, 30 wherein providing connection between user computer and one communication line

among a plurality of communication without any interruption is provided, such as disconnecting one primary communication line and connecting one backup communication line user computer when the response of primary communication line gets downed, or slower than the criteria, disconnecting the said backup communication  
5 line and connecting said primary communication line when said communication line recovers it's normal state, resuming connection with user computer.

This present invention in order to achieve said purpose provides an apparatus supporting a plurality of broadband communication lines and fallback routing method thereof comprising units such as ping module checking line state of each  
10 communication line by implementing ping test to said every communication line, disconnecting and switching module which disconnects and switches communication line to be connected to said user computer, central processing unit implementing fallback function by the way of disconnecting the connection between said user computer and said primary communication line when the response of primary  
15 communication line gets downed, or slower than the criteria, connecting one backup communication line of remaining communication lines except said primary line which have Internet accessibility to said user computer, implementing periodical ping test to said every communication line, and disconnecting said user computer with backup communication line, when the ping test of primary communication line recovers it's  
20 communication line, when the ping test of primary communication line recovers it's normal state, connecting said primary communication line to said user computer again, memory unit including Flash ROM storing fallback function code in compressed format and RAM which stores decompressed code for fallback function code and provides to central processing unit, communication line connection part including a plurality of  
25 transformers implementing signal interface function between said each network interface card and said communication line and a plurality of network interface cards being connected in accordance with said a plurality of communication lines as well as connected said central processing unit via internal bus, switching part being connected said central processing unit via internal bus and providing internal speed to said central processing unit by disconnecting and switching, if necessary, and user computer  
30 connection part comprising transformer implementing signal interface function between

at least one user computer and said switching part.

Preferably, said central processing unit may additionally include a trace route module, which provides the result of said trace route test after said central processing unit analyzes line status of each communication line by implementing trace route test to said every communication line.

Also, this present invention in order to achieve said purpose provides, a fallback routing method of an apparatus supporting a plurality of broadband communication lines characterized in that fallback routing method of an apparatus supporting a plurality of broadband communication lines connecting at least one user computer to one communication line among a plurality communication lines comprises:

The step 1 connecting said user computer and one primary communication line among a plurality of communication lines, and periodically conducting ping test;

According to ping test in said the step 1, the step 2, firstly, disconnecting the connection between said user computer and said primary communication line when the response of primary communication line gets downed, or slower than the criteria and, secondly, altering to the one of remaining communication lines except said primary line which have Internet accessibility, and periodically conducting ping test; and

According to ping test in said the step 2, the step 3, firstly, disconnecting the connection between said user computer and backup communication line being used when the response of said primary communication line gets better performance than the criteria and, secondly, connecting said primary communication line to said user computer, and returning to said the step 1.

Preferably, primary communication line wherein said the step 1 is provided, may be set as fastest communication line in the response of ping test conducted to said every communication line when said an apparatus supporting a plurality of broadband communication lines gets power at initial stage.

Preferably, it may cross-check communication line status by checking

the number of receive and transfer packet bytes, and errors during specific time period in addition to checking as normal status in the result of ping test, wherein said step is provided.

Preferably, communication line status, wherein said step 1 and said step 5 2 are provided, may be known from the result reflected from both the response time conducted as ping test and the response time conducted as trace route test to said every communication line.

Preferably, it may be connected to one communication line that is possible in connecting to Internet access among a plurality of communication lines and 10 user computer by altering gateway address, wherein said step is provided.

Preferably, it may be connected to one communication line that is possible in connecting to Internet access among a plurality of communication lines and user computer by using packet mark in available iptables of OS(Operating System) kernel, wherein said step is provided.

The said fallback function means a function that disconnecting and 15 switching to one of a plurality of communication lines except primary communication line when the response of primary communication line gets slowed or downed, wherein a plurality of communication lines are connected, and restoring connection to the specific communication line as soon as corresponding specific communication line 20 recovers it's performance.

#### BEST MODE FOR CARRYING OUT THE INVENTION

Hereinafter, "An apparatus connected multi IP broadband line and fallback method thereof" will be explained in detail according to an embodiment of the 25 present invention.

FIG. 2 shows a diagram explaining Internet connection routing method by using apparatus supporting a plurality of communication lines according to an embodiment of this present invention,

An apparatus (204) supporting a plurality of broadband lines according 30 to an embodiment of this present invention, comprises a plurality of computer

connectors and communication line connectors, while transferring the traffic of a plurality of user computers (201, 203) to a specific communication line.

The said a plurality of user computers (201, 203) are directly connected either to computer connector attached to an apparatus (204) supporting a plurality of broadband lines without being connected to hub(202) or to computer connector via hub(202).

Also, high speed WAN communication lines (Line1, Line2, Line3) such as dedicated line in order to access Internet, xDSL, cable TV line, power line cable(PLC) etc. can be connected to communication line connector attached to an apparatus(204) supporting a plurality of communication lines.

FIG. 3 shows a block diagram explaining internal configuration of an apparatus (204) supporting a plurality of broadband communication lines shown in FIG. 2. This apparatus (204) supporting a plurality of communication lines includes fallback function such as disconnecting the connection between said user computer and primary communication line when the response of primary communication line gets downed, or slower than the criteria, connecting one backup communication line of remaining communication lines that have Internet accessibility except said primary line which have Internet accessibility to said user computer, implementing periodical ping test to said every communication line, and disconnecting said user computer with backup communication line, when the ping test of primary communication line recovers it's normal state, connecting said primary communication line to said user computer, central processing unit (301) implementing fallback function, and Flash ROM (302) storing fallback function and operating system code in compressed format, RAM (303) decompressing code out of Flash ROM(302) embedding operating system and fallback function code in compressed format, means for connecting communication line (305~313) connected to central processing unit via internal bus (304) supporting a plurality of communication lines, and means for computer connection (314~316) supporting computers connected directly to these a plurality of communication lines or via hub. Herein, ISA, MII, PCI, or other means of buses can be used as internal bus.

The communication line connection means (305~313) comprises a

plurality of NICs(network interface card : referred to hereinafter as "NIC") (305, 306, 307) connected to central processing unit (301) through internal bus(304), a plurality of transformers(308, 309, 310) to implement signal interface function between each NIC and communication line, and a plurality of communication lines connectors(311, 312, 5 313) to connect communication lines.

Computer connection means (314~316) comprises switching part (314) disconnecting and switching internal speed of connection device connected to central processing unit (301) with the range of 10 Mbps~100 Mbps, transformer (315) implementing signal interface function between user computer connected directly or via hub and switching part (314), and computer/hub connector (316).  
10

Central processing unit(301) mentioned above comprises RISC CPU operated by Linux (or Windows) as OS(operating system) and Flash ROM embedding OS code and routing firmware.

An apparatus supporting a plurality of broadband lines comprises  
15 Flash ROM(302) which embeds operating system and fallback function code in compressed format, RAM(303) decompressing code out of Flash ROM(302) embedding operating system and fallback function code in compressed format, and central processing unit conducting fallback function as result of being provided decompressed code from RAM (303), wherein an apparatus supporting a plurality of broadband lines is  
20 provided.

Central processing unit (301) in an apparatus (204) supporting a plurality of broadband lines according to an embodiment of this present convention realizes fallback function by conducting ping (packet Internet groper) test. To realize fallback function, central processing unit (301) as shown in FIG. 4 comprises ping module, disconnecting and switching module, and trace route module (43).  
25

Generally, gateway address that is possible to make Internet connection can be registered in routing table. When user requests Internet connection, data can be transferred via gateway registered in corresponding routing table. Kernel for writing routing table can be operated in central processing unit (301). Routing table can be added or written by "ip route add" command in Linux. Also, after boot up process at  
30

initial stage, gateway information in routing table can be updated or written, since central processing unit (301) gets information from DHCP (Dynamic Host Configuration Protocol) server of each communication line.

Ping module (41) in order to check connection status of specific system  
5 on network, transfers ICMP response request to remote host and shows corresponding response result. This response result shows corresponding communication line state.

Disconnecting and switching module (42) enables Internet user to utilize Internet access by registering gateway address in routing table that is accessible to Internet, and deleting gateway address in routing table that is not accessible to Internet.

10 Trace route module (43) traces path to access network host or device, and shows response time to network path and corresponding path in order to reach specific TCP/IP address. This trace response time shows the state of corresponding communication line, since it varies with network loading.

15 Higher accuracy in line state of said corresponding communication line can be obtained by adding, reflecting both response time in ping module (41) following ping test to every communication line and response time in trace route module (43) following trace route test

20 FIG. 5 shows a flowchart explaining the fallback routing method of an apparatus (204) supporting a plurality of broadband lines according to this present invention.

Ping module (41) in central processing unit (301) checks the response time (S52, S53) for conducting ping test to DNS server of each communication line, after boot up (S51).

25 The DNS server address of each communication line can be automatically updated for power-on of an apparatus (204) supporting a plurality of broadband lines when corresponding DNS server assigns dynamic IP address to it, or manually set if necessary. Thus, ping test enables to check the state of each communication line.

30 Disconnecting and switching module (42) configures a communication line having fastest response speed as primary line by checking ping response time of

each communication line in initial ping test (S54). However, this primary communication line can be manually set. When at least 2 communication lines have same ping response time, the smallest number line can be set as a primary line (line 1 as a primary line, if line 1 and line 2 have same ping response time.). Herein, it is assumed that line 1 is set as a primary line. However, it is obvious that any one of communication lines could be a primary.

Ping module (41) checks periodically the status of each communication line during communication is progressing with communication line 1 as a primary line (S54). However, if communication line 1 as a primary communication line get downed, or slower than criteria, disconnecting and switching module (42) disconnects and switches communication line 1 as a primary line to other backup communication line (to communication line 2 or communication line3) that has better ping response time.

Disconnecting and switching module (42) enables Internet user to utilize Internet access by altering router information in routing table and gateway information to gateway address of backup communication line.

That is, disconnecting and switching module (42) enables to communicate via communication line 2 or communication line 3 as a backup communication line by altering gateway address registered in routing table. Even at this time, ping module (41) conducts periodically ping test to each communication line(S56).

As a result of periodic ping test, if the ping test of primary communication line recovers it's normal state (S57), disconnecting and switching module (42) enables Internet user to utilize Internet access through communication line 1 by altering router information in routing table to gateway address (S58).

Although this invention is explained based on a preferred embodiment, the embodiment is only to exemplify but not to limit the present invention. To a skilled person in this art, it will be apparent that any change, alteration or modulation from the embodiment without departing from the technical idea of the present invention can be easily made. Attached claims should be interpreted as comprehension of such change, alteration or modulation.

However, from time to time, it happens that ping module (41), checking

corresponding communication traffic state, receives the response according to packet issued by gateway, even though corresponding communication line stays downed.

Accordingly, to clearly understand the communication line state, the embodiment of this present invention could be judged by cross-checking the number of 5 receive and transfer packet bytes, and errors in network interface card (305~307) for about 2~3 seconds.

If a primary communication line get downed, or slower than criteria, disconnecting and switching module (42) changes router information table and gateway information in routing table to backup communication line. In this case of checking 10 corresponding communication traffic state according to ping test, as mentioned above, it happens that ping module (41) receives the response according to packet issued by gateway, even though corresponding communication line stays downed.

Therefore, the said disconnecting and switching module (42) disconnects and switches communication line by using packet mark of iptables available 15 in OS(operating system) kernel 2.4.

Therefore, the disconnecting and switching module (42) makes an additional user routing table that has higher priority than already existing routing table. For example, if disconnecting and switching module (42) marks '1' to packet coming into said an apparatus supporting a plurality of broadband communication lines, packet 20 marked as '1' via routing table 1 would pass through primary communication line 1. Also, judged as down state by checking communication line, packet marked as '1' via routing table 1 would pass through backup communication line that has Internet accessibility, after disconnecting and switching module (42) marks '2' to packet coming into said an apparatus supporting a plurality of broadband communication lines.

#### INDUSTRIAL APPLICABILITY

As explained in detail above, an apparatus connected multi IP broadband line and fallback method thereof according to this present invention provides the enhanced stability in Internet connection, wherein an apparatus supporting a plurality

of broadband communication lines is provided, by periodically checking primary communication line by the means of ping test, automatically disconnecting communication traffic and switching to other normal communication line with no interruption when the response of primary communication line gets downed, or slower than the criteria, resuming primary communication when the primary communication line recovers.

CLAIMS

What is claimed is:

1. Wherein an apparatus supporting a plurality of broadband communication lines connecting between at least one user computer and one communication line among a plurality of communication lines is provided,

5 an apparatus supporting a plurality of broadband communication lines comprising:

10 central processing unit which comprises ping module checking line state of each communication line by implementing ping test to said every communication line, disconnecting and switching module which disconnects and switches communication line to be connected to said user computer;

15 central processing unit which performs fallback routing function by the way of disconnecting the connection between said user computer and said primary communication line when the response of primary communication line gets downed, or slower than the criteria, connecting one backup communication line of remaining communication lines except said primary line which have Internet accessibility to said user computer, implementing periodical ping test to said every communication line, and disconnecting said user computer with backup communication line, when the ping test of primary communication line recovers it's normal state, connecting said primary communication line to said user computer again;

20 memory unit including Flash ROM storing fallback function code in compressed format and RAM which stores decompressed code for fallback function code and provides to central processing unit;

25 communication line connection part including a plurality of transformers implementing signal interface function between said each network interface card and said communication line;

a plurality of network interface cards being connected in accordance with said a plurality of communication lines as well as connected said central processing unit via internal bus;

30 switching part being connected said central processing unit via internal

bus and providing internal speed to said central processing unit by disconnecting and switching, if necessary;

user computer connection part comprising transformer implementing signal interface function between at least one user computer and said switching part.

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2. An apparatus supporting a plurality of broadband communication lines according to claim 1 characterized in that said central processing unit comprises trace route module which checks line state of each communication line by conducting trace route test to said every communication line, and then provides the result of said trace route test to said disconnecting and switching module in addition to said disconnecting and switching module.

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15  
3. A fallback routing method of an apparatus supporting a plurality of broadband communication lines characterized in that fallback routing method of an apparatus supporting a plurality of broadband communication lines connecting at least one user computer to one communication line among a plurality communication lines comprises:

20 The step 1 connecting said user computer and one primary communication line among a plurality of communication lines, and periodically conducting ping test;

25 The step 2, firstly, disconnecting the connection between said user computer and said primary communication line when the response of primary communication line gets downed, or slower than the criteria and, secondly, altering to the one of remaining communication lines except said primary line which have Internet accessibility, and periodically conducting ping test; and

The step 3, firstly, disconnecting the connection between said user computer and backup communication line being used when the response of said primary communication line gets better performance than the criteria and, secondly, connecting said primary communication line to said user computer, and returning to said the step 1.

4. A fallback routing method of an apparatus supporting a plurality of broadband communication lines according to claim 3 characterized in that connected primary communication line at said the step 1 comprises the fastest communication line in terms of ping response time by conducting ping test to said every communication line 5 when said an apparatus supporting a plurality of broadband communication lines is turned on at initial stage.

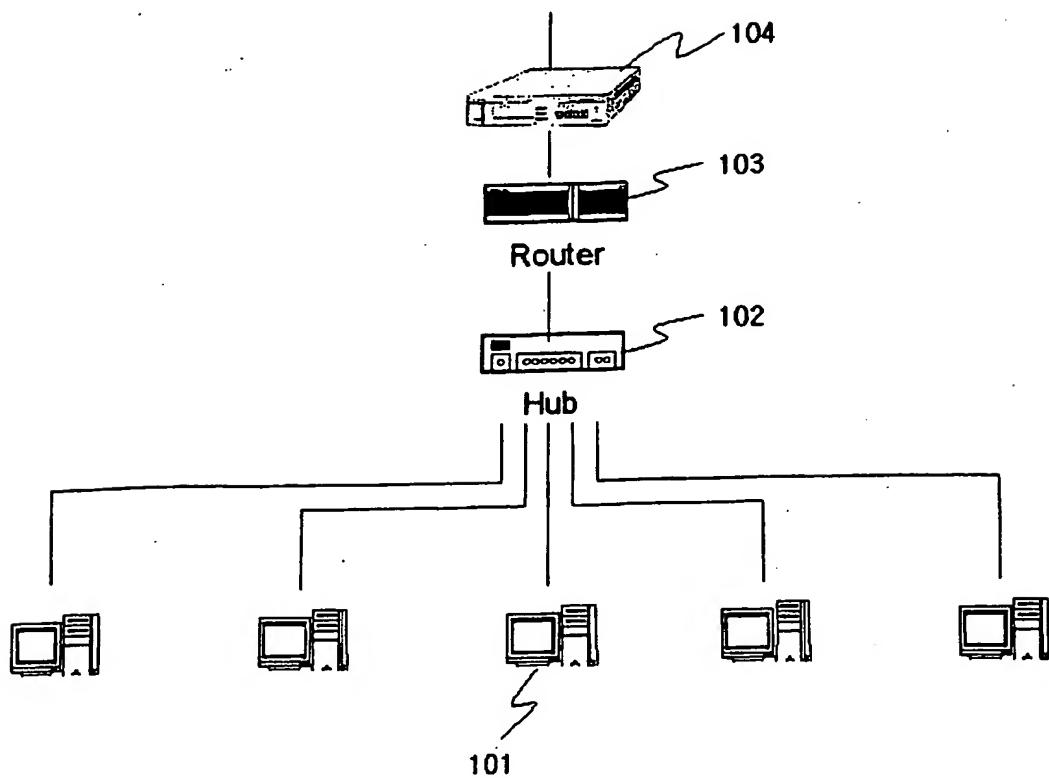
5. A fallback routing method of an apparatus supporting a plurality of broadband communication lines according to claim 3 or claim 4 comprises 10 cross-checking communication line status by checking the number of received and transferred packet bytes by network interface card, and errors during specific time period in addition to checking as normal status in the result of ping test.

6. A fallback routing method of an apparatus supporting a plurality of broadband communication lines according to claim 3 or claim 4 characterized in that the 15 line state of communication line at said the step 1 and said the step 2 comprise judging from the result reflected with both the response time conducted as ping test to said every communication line and the response time conducted as trace route test.

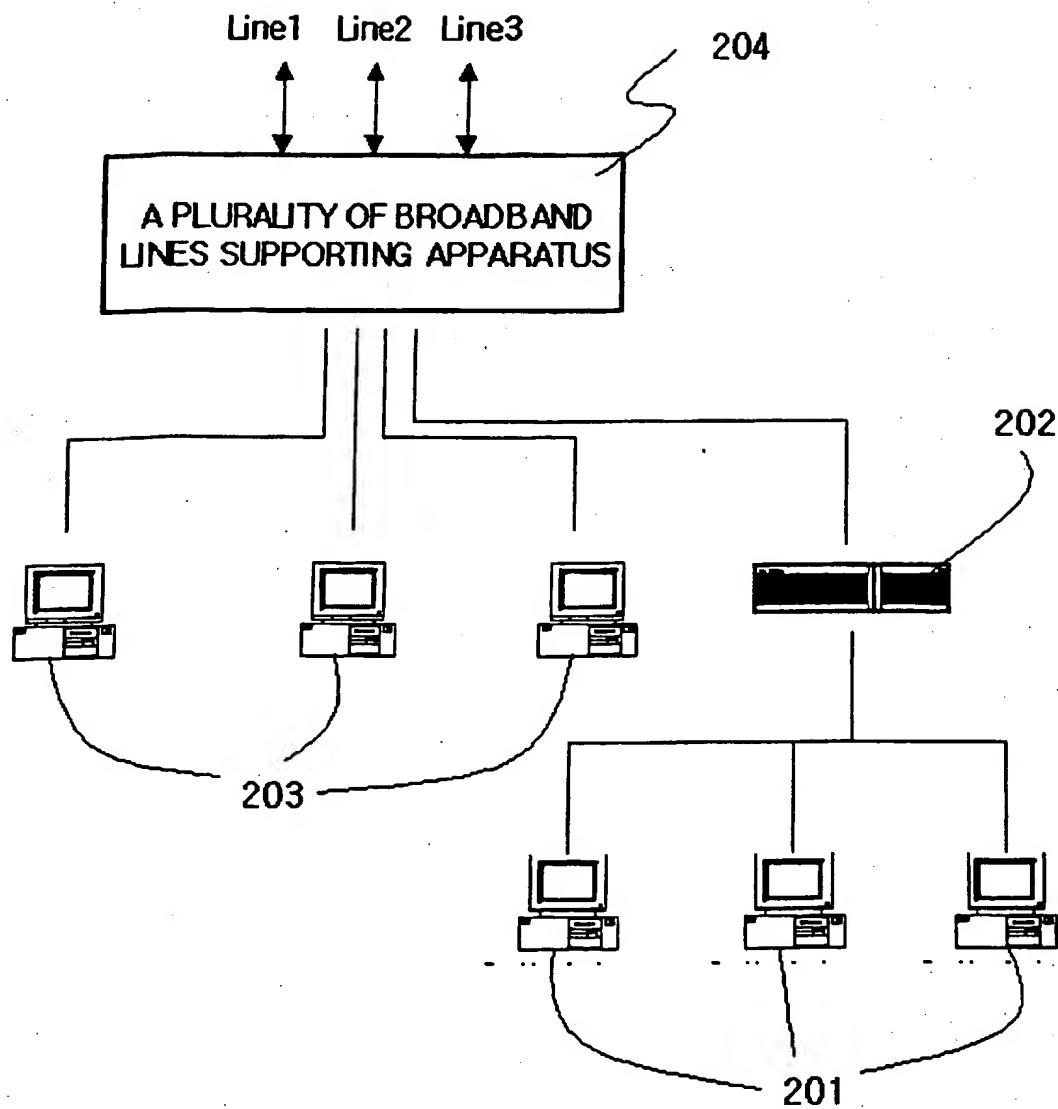
20 7. A fallback routing method of an apparatus supporting a plurality of broadband communication lines according to claim 3 comprises connecting user computer to one communication line that has Internet accessibility by changing gateway address.

25 8. A fallback routing method of an apparatus supporting a plurality of broadband communication lines according to claim 3 comprises connecting user computer to one communication line among a plurality of communication lines that have Internet accessibility by using packet mark in iptables available in OS(operating system) kernel.

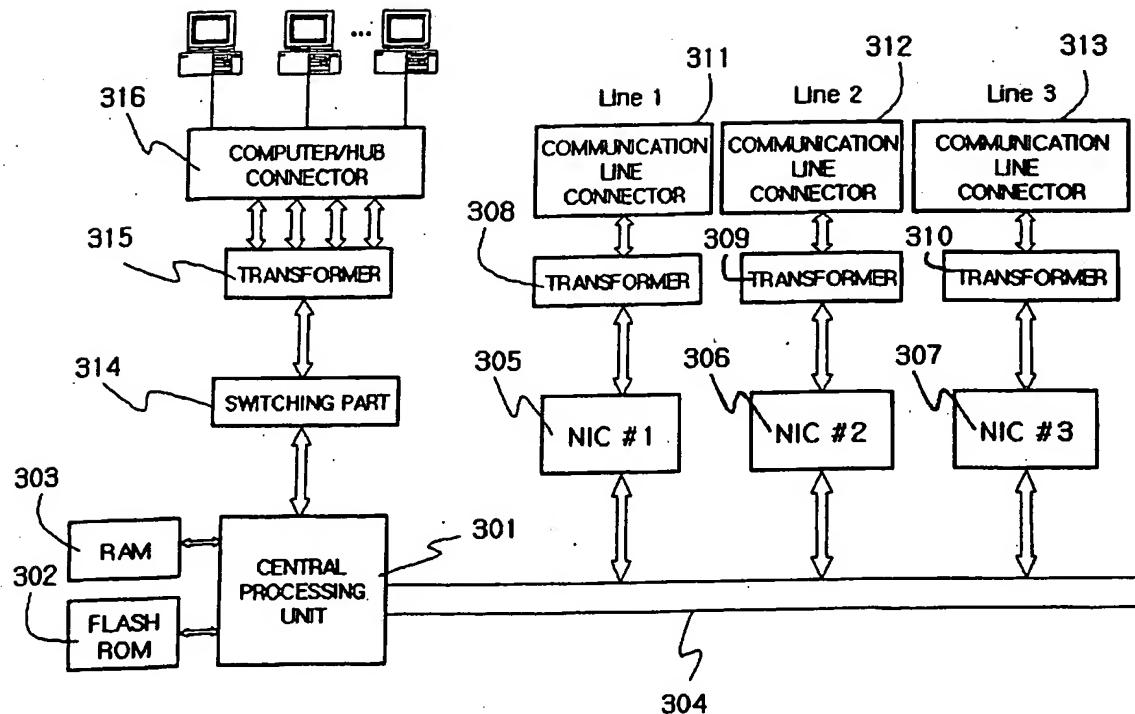
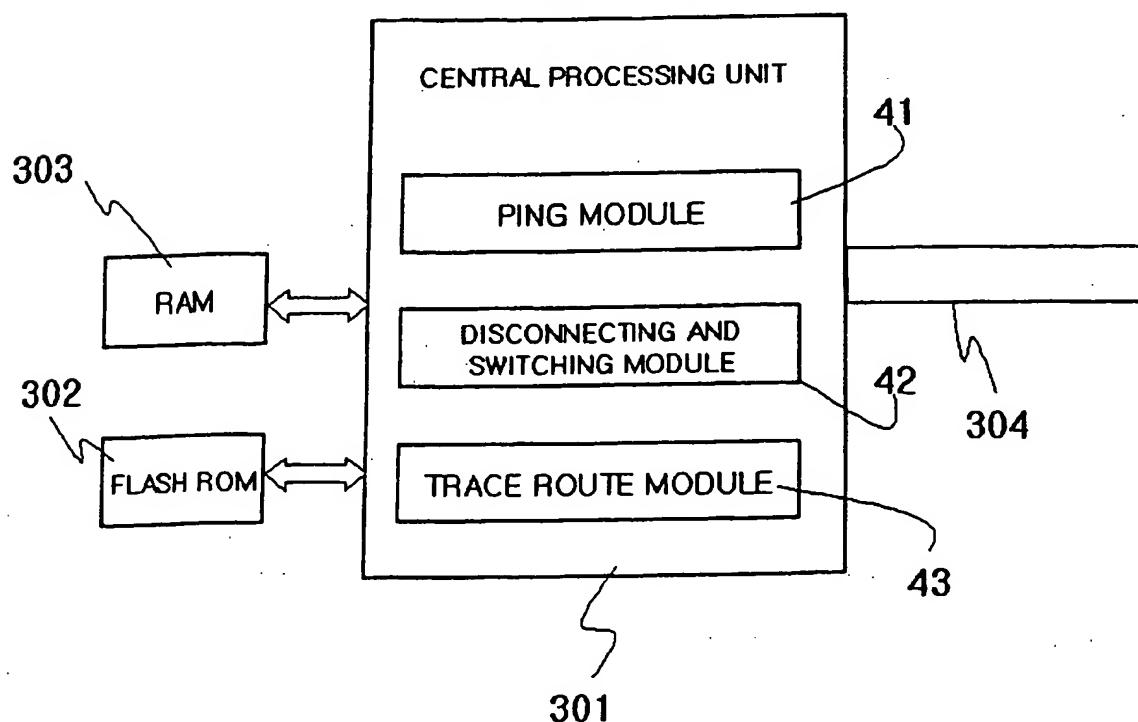
1/4

*Fig. 1*

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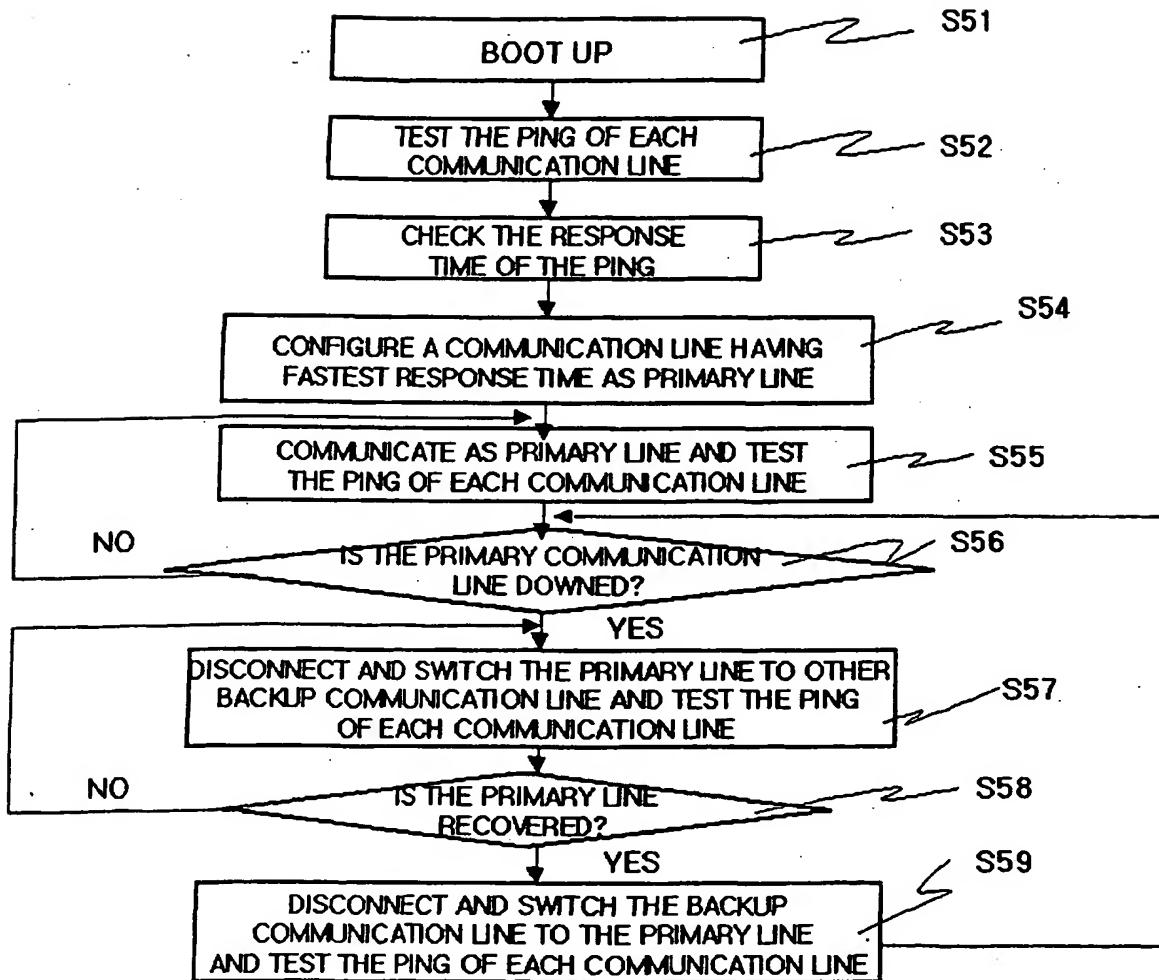
*Fig. 2*

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*Fig. 3**Fig. 4*

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Fig. 5



## INTERNATIONAL SEARCH REPORT

International application No. PCT/KR02/01550
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## A. CLASSIFICATION OF SUBJECT MATTER

**IPC7 H04L 12/66**

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7 G06F13/00, G06F11/00, H04J3/02, H04J3/26

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Patents and applications for inventions since 1990

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)  
ESPACENET "multi", "IP", "computer", "fallback"

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US, 6064671 (KILLIAN MICHAEL G (US)), 16 May 2000 (16. 5. 2000), see the whole document	1
A	WO, 0013091 (BLIGHTMAN STEPHEN E J (US); PHILBRICK CLIVE M (US); CRAFT PETER K (US); STARR DARYL (US); ALACRITECH CORP (US); HIGGEN DAVID A (US); BOUCHER LAURENCE B (US)), 9 Mar. 2000 (9. 3. 2000), see the whole document	1
A	US, 5590285 (3COM CORP (US)), 31 Dec. 1996 (31. 12. 1996), see the whole document	1
A	US, 5572533 (FUJITSU LTD (JP)), 5 Nov. 1996 (5. 11. 1996), see the whole document	1
A	US, 5331635 (FUJI XEROX CO LTD (JP)), 19 Jul. 1994 (19. 7. 1994), see the whole document	1

 Further documents are listed in the continuation of Box C. See patent family annex.

- \* Special categories of cited documents:
- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier application or patent but published on or after the international filing date
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- "&" document member of the same patent family

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